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Phytogeographical notes on the Rocky Mountain region

II. Origin of the alpine flora*

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When studying the flora of a certain region or district, one naturally asks himself the following questions: What is the origin of these plants? Where did they come from? How did they come there? Where else are they found? Why are they found there and not in adjacent territory? Why are they there and not in other similar regions? Why are other plants found in similar regions and not there? Many other similar questions might be asked and none of them could be satisfactorily answered. We can only make suggestions and surmises. Some answers may seem satisfactory to us now, as others may have seemed satisfactory to generations gone by; others may seem merely probable, and still others not even so. The alpine regions of the Rockies are merely small isolated spots, when the whole mountain range is considered. They can be compared with a number of small islands, now surrounded (so far as many of the species are concerned) by barriers insurmountable, more so even than islands in an ocean could ever be. It is far easier to tell what an alpine plant is (and I have already in a former paper tried to give a definition thereof) than to tell how it came there. If we had only endemic species to deal with, we should perhaps explain its existence by a spontaneous generation or as something originated from a related species, which exists or has existed in the subalpine region below. The belief in a spontaneous generation, at least so far as the higher plants or animals are concerned, is now generally discarded. The derivation from related species of the subalpine region is in many cases a satisfactory explanation of the existence of many endemic alpine species but not of all. But how shall we explain the existence of the same plant in the alpine regions of Colorado and the Alps in

* In this paper the sedges have been omitted, as they have not yet been worked up. Without an authentic determination of the species, it is risky to discuss such a critical genus as *Carex* in a phytogeographical paper.

Europe, as for instance *Potentilla nivea*, *Lloydia serotina* and *Viola biflora*? This question leads to other related ones. Has a species originated only once or can the same plant arise at the same time or at different times at two or more isolated localities? Are the individuals of *Potentilla nivea*, now growing in Colorado, in the Alps, in Scandinavia, in Greenland, etc., offsprings of the same parent *Potentilla nivea* living ages ago, or did the species originate independently at the different places? In the case of *Potentilla nivea*, I rather think that it is monotypic and has had a much more general distribution than it now has, for it is a common plant in the arctics. But this is not the case with *Viola biflora*, which is not an arctic plant. Until lately the only localities known in this country were in Colorado, but now it is known also from Alaska.

It is not, however, impossible that some so-called species have had a polytypic origin. *Primula farinosa* is a plant of the Alps, northern Europe, northeastern America, and apparently the same plant is found in south Chile to Terra del Fuego. In both cases, however, the plant itself or else the parent plant, from which it originated, must have had a much greater distribution than it now has. We know of many plants which in earlier periods have been distributed over much greater territory than they now are, as for instance *Ginkgo biloba* and *Taxodium distichum* were once found in Europe, while they now are restricted, the former to northeastern Asia and the latter to the southern United States.

It was stated before that many of the alpine plants of the Rockies are also arctic or subarctic, and as far as the Rockies are concerned the seeds could be carried by wind and animals from mountain top to mountain top, as the stretches are not so far, the mountain chain running north and south, but this would not be a satisfactory explanation in Europe and Asia where the principal chains run east and west and at a great distance from the arctic. Another explanation must therefore be given. The most plausible and most generally accepted theory concerning the origin of the alpine flora is the following. In the glacial periods, the regions in front of the ice-sheet became unfit for the woody vegetation and in fact for all plants except the arctic-alpine elements. The forest receded south in front of the advancing ice. The temperature in the mountain regions south thereof became lower and lower, the

glaciers increased and extended downwards and the forests receded down the mountain sides. At last the foothills and even the plains of northern Europe, Asia and America received an alpine-arctic climate and bore mostly arctic vegetation. As the ice sheet receded, the climate became more temperate, the forest again took possession of the land and the arctic plants were partly driven towards the pole, partly up the mountains, until in our days they are confined to the arctic regions and the highest mountain tops, where they have become isolated. In America the glacial drifts did not reach as far south as Colorado, but evidently the temperature during the glacial epoch must have been low enough, so that the local glaciers of the Rockies may have covered most of the mountains, and the great plains and the foothills surrounding them undoubtedly had an arctic or subarctic climate at that time. Many of the arctic plants had originated before the glacial period and had spread over the two continents. Some of these still exist on both, others might have died out on one of the continents, but remain on the other. Some might become exterminated in the mountain regions while continuing their existence in the arctic regions, or vice versa. Some, after isolation, might have changed in the course of time and developed into new species. This is perhaps more common in the case of the alpine than of the arctic plants. The arctic-alpine plants may therefore be classified in the following categories.*

1. Circumpolar arctic-alpine or glacial plants, found in the arctic as well as in the mountain regions of both continents.

2. Eurasian arctic-alpine or glacial plants, found only in the mountains of the Old World and the arctic regions. Some of these may be:

(a) European arctic-alpine or glacial plants, with the center of distribution in the Alps;

(b) Asiatic arctic-alpine or glacial plants, with the center in the Altai.

3. American arctic-alpine or glacial plants, confined to the mountains of the New World and the arctic.

* Here I do not include the alpine plants of tropical regions, which must be considered altogether by themselves.

4. Eurasian alpine plants, found in the mountains of the Old World, but not in the arctic regions. The principal subdivisions of this group are:

(a) Alpestrian, endemic plants of the European Alps, including the Pyrenees and the Caucasus;

(b) Altaic, north Asiatic alpine plants.

5. American endemic alpine plants. The principal regions of these are the following:

(a) Sierra Nevada, including the Cascade Mountains, which latter, however, contain an intermixture of some elements belonging to the next;

(b) Rocky Mountains, including the San Francisco Mountains and the other ranges of Arizona, New Mexico and northern Mexico;

(c) White Mountains. Most of the plants of this region belong to the arctic-alpine group, but endemic alpine plants are not wholly lacking, as for instance, *Potentilla Robbinsiana* and *Sieversia Peckii*.

6. Circumpolar arctic plants, not found in the mountains.

7. Eurasian arctic plants, which do not concern us at all.

8. American arctic plants.

9. Subarctic and

10. Subalpine plants, which encroach on the arctic and alpine regions.

CIRCUMPOLAR ARCTIC-ALPINE OR GLACIAL PLANTS

These species probably had originated before or during the glacial epochs. In some cases the origin probably was somewhere in the Old World, in others in the New World. Of course, we cannot know, but we may surmise. The region which contains the most numbers of certain groups of species may probably be the place where this group originated (*i. e.* the home of the parent species) and where the individual species sprang from. As for instance, there is a group of arctic-alpine species of *Potentilla* with ternate leaves white-wooly beneath. *Potentilla nivea* is the most generally distributed species of the group; it is also the first and best known. Where is the probable ancestral home of this species? The species is found in Europe, rather common in the Scandinavian mountains,

but not so common in the Alps. It is the only species of the group there. It is, therefore, not probable that its ancestry came from that region. The group is represented in both North America and Asia by several species. The American species, except *P. nivea* and *P. uniflora*, are rather local, and are modified to adapt themselves to local conditions. Both *P. nivea* and *P. uniflora* as well as *P. villosa* (found in the northwestern corner of this continent) are found in Asia, together with several others of the group. *P. nivea* itself is common there in the mountains as well as in the arctic, while it has been collected only at a few places in the Rockies of Colorado. It is therefore probable that the group originated in Asia.

Let us now discuss the plants of this category. The following plants are common to the arctic regions of both continents, the Alps, and the Rockies as far south as Colorado. Most of these are also found in Asia. Those with a star are also found in the subalpine regions.

* <i>Phleum alpinum</i>	<i>Salix reticulata</i>
* <i>Trisetum subspicatum</i>	<i>Oxyria digyna</i>
* <i>Deschampsia caespitosa</i>	* <i>Bistorta vivipara</i>
<i>Poa cenisia</i>	<i>Silene acaulis</i>
* <i>Poa alpina</i>	<i>Thalictrum alpinum</i>
<i>Festuca supina</i>	<i>Ranunculus pygmaeus</i>
* <i>Festuca ovina</i>	<i>Draba fladnizensis</i>
* <i>Festuca rubra</i>	<i>Muscaria adscendens</i>
<i>Juncus triglumis</i>	<i>Potentilla nivea</i>
<i>Juncus castaneus</i>	* <i>Astragalus alpinus</i>
* <i>Juncoides spicatum</i>	<i>Campanula uniflora</i>
<i>Lloydia serotina</i>	<i>Myosotis alpestris</i>

Some of these species extend into mountains situated so far south that they could not have been connected with the arctic regions even in the glacial times. The existence of these species there has to be explained in some other way. In most cases their seeds were probably carried by birds or other animals or by the wind. Included among such plants are the following:

Lloydia serotina, a typical arctic-alpine plant, is found not only in the arctic regions, the mountains of northern Europe and Asia, the Alps, the Rockies and the Sierra Nevada, but also in

mountains farther south, as the Pyrenees, the Caucasus, the Himalayas, and, in America, in the San Francisco Mountains, Arizona. Like most bulbiferous plants, it does not readily propagate by seeds, but when these are formed, they may easily be distributed by the wind on account of their flatness.

Juncoides spicatum has about the same distribution except that it is not found in the Himalayan region. The seeds of this species must have been carried by birds as they are too heavy to be carried by wind.

Poa alpina extends south to the Sierra Nevada (Spain), the Appennines, and the Himalayas, and *Trisetum subspicatum* and *Phleum alpinum* extend in America south through the mountains of Mexico, Central and South America. As these grasses also are subalpine, their seeds have probably been distributed by animals.

The following two species are common to the arctic regions of both hemispheres, to the Rockies, and to the Asiatic mountains, but not found in the Alps: *Draba glacialis* and *Anemone parviflora*.

Saxifraga cernua and *Campanula uniflora* are circumpolar glacial plants, but do not reach the Alps. They are found in America as far south as Colorado and Utah. Either these plants are of American origin and have extended their range over northern Europe, or else they have perished in the Alps.

The same may be said about *Micranthes hieracifolia*, although it does not reach the southern Rockies.

Aster alpinus is a glacial plant found both in the Alps and the Altai, rare in the Rockies and lacking altogether in the Scandinavian mountains.

Some of the circumpolar glacial plants, although they are found on this continent, are found neither in the southern Rockies nor in Sierra Nevada, although they are found in both the Alps and the Altai. Such are:

Cerastium alpinum
Erigeron alpinum

Chondrosea Aizoon
Micranthes nivalis

The first two are, however, represented by related endemic species.

A few of these circumpolar plants are found in the Alps, but neither in the Altai nor in the southern Rockies, as for instance

Tofieldia palustris. This is found in Great Britain, Scandinavia, northern Russia, the Alps, the Pyrenees and the Ural. Notwithstanding the fact that it is less distinctly arctic-alpine than for instance *Lloydia serotina* and has been collected in the lowland as far south as Two Harbors, Minnesota, it has not been collected in the Rockies south of northern Montana.

ASIATIC ARCTIC-ALPINE OR GLACIAL PLANTS

Dasystephana glauca is a distinctly Asiatic glacial plant, but also found in western North America, coming down south as far as Montana.

AMERICAN ARCTIC-ALPINE OR GLACIAL PLANTS

A large number of the alpine plants of the Rockies are strictly American glacial plants, i. e., found both in the mountains and the arctic regions of this continent but not in the mountains of the Old World.

1. In many cases they are there represented by closely related plants. In such cases the history of the plant might be the following:

(a) That the parent plant had a circumpolar distribution before or during the earlier part of the glacial period and the two related species developed independently from it;

(b) That the Old World plant existed on both continents during the glacial epoch and became modified after isolation on this side; or

(c) That the American plant existed and became modified abroad.

Here I give a list of such plants and the nearest relatives in the Old World.

AMERICAN	EUROPEAN	ASIATIC
* <i>Calamagrostis purpurascens</i>	<i>C. arundinacea</i>	
<i>Salix glaucops</i>	† <i>S. glauca</i>	
<i>Salix chlorophylla</i>	<i>S. phyllicifolia</i>	
* <i>Alsinopsis propinqua</i>	<i>A. verna</i>	

* Those starred are also subalpine and subarctic.

† *Salix glauca* and *Rhodiola rosea* are also found in northeastern America, but not in the Rockies.

AMERICAN	EUROPEAN	ASIATIC
<i>Alsinopsis quadrivalis</i>	<i>A. verna</i>	
<i>Alsinopsis Rossii</i>	<i>A. verna</i>	
<i>Anemone zephyra</i>	<i>A. narcissiflora</i>	<i>A. narcissiflora</i>
<i>Ranunculus affinis</i>		<i>R. pedatifidus</i>
<i>Smelowskia americana</i>		<i>S. calycina</i>
<i>Rhodiola integrifolia</i>	† <i>R. rosea</i>	
<i>Leptasea austromontana</i>		<i>L. bronchialis</i>
* <i>Potentilla quinquefolia</i>	<i>P. nivea</i>	<i>P. nivea</i>
<i>Potentilla nipharga</i>	<i>P. nivea</i>	<i>P. nivea</i>
<i>Vaccinium oreophilum</i>	<i>V. Myrtillus</i>	
<i>Androsace carinata</i>	<i>A. Chamaejasme</i>	<i>A. Chamaejasme</i>
<i>Androsace albertina</i>	<i>A. Chamaejasme</i>	<i>A. Chamaejasme</i>
* <i>Swertia palustris</i>	<i>S. perennis</i>	<i>S. perennis</i>
<i>Amarella monantha</i>	<i>A. tenella</i>	<i>A. tenella</i>
<i>Amarella plebeia</i>	<i>A. Amarella</i>	<i>A. Amarella</i>
<i>Dasystephana Romanzovii</i>	<i>D. Froelichii</i>	<i>D. frigida</i>
<i>Condrophylla americana</i>	<i>C. prostrata</i>	<i>C. prostrata</i>
<i>Polemonium pulcherrinum</i>		<i>P. humile</i>
<i>Erigeron simplex</i>	<i>E. uniflorus</i>	<i>E. uniflorus</i>
<i>Erigeron melanocephalus</i>	<i>E. uniflorus</i>	<i>E. uniflorus</i>
<i>Artemisia saxicola</i>	<i>A. norvegica</i>	
<i>Artemisia spithamea</i>		<i>A. borealis</i>

Many of the endemic American glacial plants—or rather alpine-arctic plants, for most of them undoubtedly originated after the glacial period—are evidently derived from existing circumpolar glacial plants. Such are:

AMERICAN GLACIAL	CIRCUMPOLAR GLACIAL
<i>Deschampsia curtifolia</i>	<i>D. caespitosa</i>
<i>Poa arctica</i>	<i>P. cenisia</i>
* <i>Festuca saximontana</i>	<i>F. ovina</i>
<i>Agropyron biflorum</i>	<i>A. caninum</i>
<i>Cerastium Behringianum</i>	<i>C. alpinum</i>
<i>Draba andina</i>	<i>D. glacialis</i>
<i>Draba oligosperma</i>	<i>D. glacialis</i>

Some of these arctic-alpine plants had probably the same

parents as some existing circumpolar-arctic plants. While one offspring has remained arctic, *i. e.* has not spread south during the glacial period or else has died out in the alpine regions, the other has become both alpine and arctic with a purely American distribution, or else the latter has developed from the former since glacial time. Such plants are:

NORTH AMERICAN ARCTIC-ALPINE	CIRCUMPOLAR ARCTIC
<i>Chrysosplenium tetrandrum</i>	<i>C. alternifolium</i>
<i>Antennaria media</i>	<i>A. alpina</i>
* <i>Antennaria umbrinella</i>	<i>A. alpina</i>

A few strictly arctic plants have for some reason spread into the Rockies, their existence there being a little hard to explain. Among these may be mentioned *Phippsia algida*, which has been collected in one place in Colorado. It is otherwise not known out of the arctic. *Sagina nivalis* has been found in Colorado; otherwise only in the arctic regions of America and in the Scandinavian mountains.

The following are truly endemic American arctic-alpine plants without any close relatives as far as I know elsewhere:

<i>Ranunculus hyperboreus</i>	* <i>Erigeron compositus</i> and its close relatives, viz.
<i>Aragallus podocarpus</i>	* <i>Erigeron multifidus</i>
* <i>Vaccinium caespitosum</i>	<i>Erigeron trifidus</i>

The following are probably derived from subarctic or subalpine species:

* <i>Calamagrostis Langsdorffii</i> †	<i>C. canadensis</i> , American, subalpine and boreal.
* <i>Alsine laeta</i>	<i>A. longipes</i> , American, subarctic, subalpine and boreal.
* <i>Kalmia microphylla</i>	<i>K. glauca</i> , eastern American, subarctic and boreal.
* <i>Senecio cymbalarioides</i>	<i>S. aureus</i> , eastern American, boreal.

† This is also found in subarctic Scandinavia.

AMERICAN ENDEMIC ALPINE PLANTS

More than one third of the alpine plants of the Rockies are endemic and if the subalpine element found just over the timberline, or occasionally higher up, is included, this proportion is increased to about half of all the species. Several of these are apparently derived from circumpolar glacial or arctic plants.

SOUTHERN ROCKIES	CIRCUMPOLAR GLACIAL OR ARCTIC
<i>Deschampsia alpicola</i>	<i>D. caespitosa</i>
<i>Ranunculus Macauleyi</i>	<i>R. nivalis</i>
<i>Parrya platycarpa</i>	<i>P. macrocarpa</i>
<i>Leptasea chrysantha</i>	<i>L. Hirculus</i>
<i>Muscaria delicatula</i>	<i>M. caespitosa</i>
<i>Muscaria micropetala</i>	<i>M. caespitosa</i>
<i>Saxifraga debilis</i>	<i>S. rivularis</i>
<i>Saxifraga simulata</i>	<i>S. cernua</i>
<i>Potentilla modesta</i>	<i>P. nivea</i> (perhaps through <i>P. quinquefolia</i>)

NORTHERN ROCKIES	CIRCUMPOLAR GLACIAL OR ARCTIC
<i>Salix nivalis</i>	<i>S. reticulata</i>
<i>Draba lonchocarpa</i>	<i>D. nivalis</i>
<i>Muscaria monticola</i>	<i>M. caespitosa</i>
<i>Micranthes Rydbergii</i>	<i>M. hieracifolia</i>
<i>Micranthes crenatifolia</i>	<i>M. nivalis</i>
<i>Spathularia Vreelandii</i>	<i>S. stellaris</i>
<i>Phyllodoce empetriformis</i>	<i>P. coerulea</i>
<i>Phyllodoce glanduliflora</i>	<i>P. coerulea</i>
<i>Cassiope Mertensiana</i>	<i>C. tetragona</i>

SOUTHERN AND NORTHERN ROCKIES	CIRCUMPOLAR GLACIAL OR ARCTIC
<i>Micranthes rhomboidea</i>	<i>M. nivalis</i>
<i>Micranthes arnoglosa</i>	<i>M. nivalis</i>
<i>Taraxacum scopulorum</i>	<i>T. arcticum</i>
<i>Salix saximontana</i>	<i>S. reticulata</i>

Others have no close relative on this continent, but may have the same origin as some Old World plants. A list of these is here given with the nearest relatives abroad.

NORTHERN ROCKIES	EUROPEAN	ASIATIC
<i>Salix Dodgeana</i>	<i>S. retusa</i>	
<i>Alsine americana</i>		<i>A. dichotoma</i>
<i>Leptasea Van Bruntiae</i>		<i>L. bronchialis</i>
<i>Drymocallis pseudorupestris</i>	<i>D. rupestris</i>	
<i>Eritrichium elongatum</i>	<i>E. nanum</i>	<i>E. villosum</i>

SOUTHERN ROCKIES	EUROPEAN	ASIATIC
<i>Condrophylla Fremontii</i>		<i>C. humilis</i>
<i>Anthropogon barbellatum</i>	<i>A. ciliatum</i>	
<i>Eritrichium argenteum</i>	<i>E. nanum</i>	<i>E. villosum</i>

Still other species are probably derived from, or have the same origin as, American glacial or American arctic plants.

SOUTHERN ROCKIES

<i>Poa pudica</i>	<i>P. arctica</i> , glacial
<i>Festuca minutiflora</i>	<i>F. brachyphylla</i> , glacial
<i>Salix pseudolapponum</i>	<i>S. glaucops</i> , glacial
<i>Alsine polygonoides</i>	<i>A. laeta</i> , glacial
<i>Cerastium Earlei</i>	<i>C. Behringianum</i> , glacial
<i>Caltha rotundifolia</i>	<i>C. biflora</i> , subarctic
<i>Draba pectinata</i>	<i>D. andina</i> , glacial
<i>Rhodiola polygama</i>	<i>R. integrifolia</i> , glacial
<i>Polemonium delicatum</i>	<i>P. pulcherrimum</i> , glacial
<i>Castilleja Haydeni</i>	<i>C. pallida</i> , arctic

NORTHERN ROCKIES

<i>Agropyron andinum</i>	<i>A. biflorum</i> , glacial
<i>Agropyron latiglume</i>	<i>A. biflorum</i> , glacial
<i>Salix cascadiensis</i>	<i>S. arctica</i> or <i>S. anglorum</i> , arctic
<i>Cerastium pulchellum</i>	<i>C. Behringianum</i> , glacial
<i>Caltha leptosepala</i>	<i>C. biflora</i> , subarctic
<i>Caltha cheledoni</i>	<i>C. biflora</i> , subarctic
<i>Phacelia Lyallii</i>	<i>P. sericea</i> , glacial
<i>Polemonium parviflorum</i>	<i>P. pulcherrimum</i> , glacial
<i>Erigeron pedatus</i>	<i>E. multifidus</i> , glacial

NORTHERN AND SOUTHERN ROCKIES

<i>Bistorta linearifolia</i>	<i>B. bistortoides</i> , glacial
<i>Acomastylis turbinata</i>	<i>A. Rossii</i> , arctic
<i>Acomastylis sericea</i>	<i>A. Rossii</i> , arctic
<i>Mertensia nivalis</i>	<i>M. lanceolata</i> , glacial
<i>Castilleja occidentalis</i>	<i>C. pallida</i> , arctic

Many of the alpine plants of the Rockies have their nearest relatives among the subalpine or mountain plants of the region. Such are

NORTHERN ROCKIES

ALPINE	SUBALPINE
<i>Potentilla perdissecta</i>	<i>P. diversifolia</i>
<i>Potentilla decurrens</i>	<i>P. diversifolia</i>
<i>Pseudocymopterus Tiedestromii</i>	<i>P. montanus</i>
<i>Bupleurum purpureum</i>	<i>B. americanum</i> (related to <i>B. ranunculoides</i> of Europe)
<i>Phacelia alpina</i>	<i>P. heterophylla</i>

SOUTHERN ROCKIES

<i>Avena Mortoniana</i>	<i>A. americana</i>
<i>Poa Pattersonii</i>	<i>P. crocata</i>
<i>Eriogonum xanthum</i>	<i>E. flavum</i>
<i>Aquilegia saximontana</i>	<i>A. brevistyla</i>
<i>Thlaspi coloradense</i>	<i>T. glaucum</i> (also closely related to <i>T. alpestre</i> of Europe)
<i>Thlaspi purpurascens</i>	<i>T. glaucum</i> (also closely related to <i>T. alpestre</i> of Europe)
<i>Cheirinia amoena</i>	<i>C. Wheeleri</i>
<i>Cheirinia nivalis</i>	<i>C. Wheeleri</i>
<i>Cheirinia radiata</i>	<i>C. asperrima</i>
<i>Aragallus foliolosus</i>	<i>A. reflexus</i>
<i>Primula angustifolia</i>	<i>P. Broadheadae</i>
<i>Phlox condensata</i>	<i>P. caespitosa</i>
* <i>Mertensia Bakeri</i>	<i>M. lanceolata</i>
* <i>Mertensia lateriflora</i>	
* <i>Mertensia Parryi</i>	
* <i>Mertensia viridula</i>	
<i>Besseyia alpina</i>	<i>B. plantaginifolia</i>
<i>Achillea subalpina</i>	<i>A. lanulosa</i>

† Those marked with braces constitute groups of close y relat d species.

SOUTHERN AND NORTHERN ROCKIES

<i>Poa Lettermannii</i>	<i>P. crocata</i>
<i>Poa rupicola</i>	<i>P. crocata</i>
<i>Anemone tetonensis</i>	<i>A. globosa</i>
<i>Drymocallis pumila</i>	<i>D. glandulosa</i>
<i>Solidago decumbens</i>	<i>S. oreophila</i>
<i>Solidago ciliosa</i>	<i>S. scopulorum</i>

The following alpine plants have no close relatives and seem to have originated in the Rockies:

<i>Agropyron Scribneri</i>	<i>Oreoxis alpina</i>	}
* <i>Claytonia megarrhiza</i>	<i>Oreoxis Bakeri</i>	
<i>Paronychia pulvinata</i>	<i>Oreoxis humilis</i>	
<i>Ranunculus adoneus</i>	<i>Polemonium viscosum</i>	}
<i>Ranunculus stenolobus</i>	<i>Polemonium Grayanum</i>	
<i>Delphinium alpestre</i>	<i>Polemonium confertum</i>	
<i>Gormannia debilis</i>	<i>Polemonium speciosum</i>	}
<i>Telesonix Jamesii</i>	<i>Polemonium mellitum</i>	
<i>Telesonix heucheriformis</i>	<i>Polemonium Brandegei</i>	
<i>Potentilla saximontana</i>	<i>Douglasia nivalis</i>	}
<i>Potentilla minutiflora</i>	<i>Douglasia montana</i>	
<i>Potentilla tenerrima</i>	<i>Tonestus pygmaeus</i>	
<i>Trifolium nanum</i>	<i>Tonestus Lyallii</i>	}
* <i>Trifolium Parryi</i>	<i>Xylorrhiza coloradensis</i>	
<i>Trifolium montanense</i>	<i>Xylorrhiza Brandegei</i>	
<i>Trifolium salictorum</i>	<i>Rydbergia grandiflora</i>	}
<i>Trifolium Brandegei</i>	<i>Rydbergia Brandegei</i>	
* <i>Trifolium dasyphyllum</i>	<i>Artemisia scopulorum</i>	
* <i>Trifolium lividum</i>	<i>Artemisia Pattersonii</i>	}
* <i>Trifolium stenolobum</i>	<i>Artemisia Parryi</i>	
<i>Trifolium attenuatum</i>	<i>Senecio Holmii</i>	
<i>Trifolium bracteolatum</i>	<i>Senecio taraxacoides</i>	}
<i>Angelica Grayi</i>	<i>Senecio Soldanella</i>	
	<i>Senecio petrocallis</i>	
	<i>Senecio Porteri</i>	

AMERICAN ARCTIC PLANTS

Many plants which have their main distribution within the arctic regions of North America are also found in the northern

Rockies; only a few of these extend far enough south to reach the boundary of the United States. In other words, only a few of them reach Montana and still fewer northern Idaho.

<i>Salix alexensis</i>	<i>Artemisia Richardsoniana</i>
<i>Salix arbusculoides</i>	<i>Artemisia arctica</i>
<i>Salix Barrattiana</i>	* <i>Achillea borealis</i>
<i>Salix Drummondiana</i>	* <i>Achillea multiflora</i>
* <i>Tofieldia coccinea</i>	* <i>Senecio lugens</i>
<i>Micranthes foliolosa</i>	<i>Potentilla emarginata</i>
<i>Erigeron grandiflorus</i>	<i>Amarella arctophila</i>
<i>Erigeron lanatus</i>	<i>Amarella propinqua</i>
<i>Erigeron unalaschensis</i>	<i>Mertensia Drummondii</i>
<i>Antennaria alpina</i>	<i>Castilleja pallida</i>
<i>Antennaria monocephala</i>	

Some of these arctic plants have a circumpolar distribution, as the following:

<i>Juncus biglumis</i>	<i>Muscaria caespitosa</i>
<i>Juncoides arcticum</i>	<i>Micranthes nivalis</i>
<i>Juncoides hyperboreum</i>	<i>Cardamine bellidifolia</i>
<i>Juncoides arcuatum</i>	<i>Mairania alpina</i>
<i>Androsace septentrionalis</i>	<i>Cassiope tetragona</i>
<i>Saxifraga rivularis</i>	<i>Pedicularis lanata</i>
<i>Draba nivalis</i>	<i>Pedicularis Oederi</i>
<i>Draba alpina</i>	<i>Pedicularis flammea</i>

The following are Asiatic-American arctic plants extending into the Canadian Rockies:

<i>Cheirinia Pallasii</i>	<i>Potentilla villosa</i>
<i>Potentilla uniflora</i>	<i>Campanula lasiocarpa</i>

SUBALPINE PLANTS

Besides these, there are many of the subalpine plants which occasionally are found above timber line. If the sedges, which I have not yet recorded, are excepted, the list contains 80 such species. There is no need of giving the list in this connection. If I should discuss in a subsequent paper the subalpine region, such a list would there find its place.

* Mostly subarctic-subalpine.

The alpine plants of all classes in the Rocky Mountains number about 250 species. The subalpine plants, which sometimes are found in the alpine region, are if the sedges are added over 100 in number. Hence about 350 species of flowering plants, or between 6 and 7 per cent. of the Rocky Mountain species, are growing within the alpine region.

NEW YORK BOTANICAL GARDEN